

CLAIMS

What is claimed is:

1. A rotary cutting apparatus comprising:
 - a body;
 - a motor mounted on said body;
 - a rotary shaft assembly having an axis and adapted to hold a cutting tool coaxial with said axis; and,
 - a feed mechanism for moving said cutting tool held by said rotary shaft assembly along said axis;
 - said rotary shaft assembly comprising:
 - a proximal rotary shaft concentric with said axis and mounted on said body for rotation about said axis, said proximal rotary shaft being drivingly connected to said motor;
 - an intermediate rotary shaft concentric with said axis and telescopically connected to said proximal rotary shaft to move relative to said proximal rotary shaft along said axis between an extended position and a retracted position, said intermediate rotary shaft being rotatable together with said proximal rotary shaft;
 - a distal rotary shaft concentric with said axis and telescopically connected to said intermediate rotary shaft to move relative to said intermediate rotary shaft along said axis between an extended position and a retracted position, said distal rotary shaft being rotatable together with said intermediate rotary shaft ;
 - and,
 - a cylindrical housing concentric with said axis, said cylindrical housing rotatably holding said distal rotary shaft and being movable along said axis together with said distal rotary shaft;
 - said feed mechanism having a drive member engaged with said cylindrical housing and movable in parallel with said axis to bring said rotary shaft assembly to an extended position wherein said intermediate and distal rotary shafts

are in said extended positions thereof and to a retracted position wherein said intermediate and distal rotary shafts are in said retracted positions thereof.

2. A rotary cutting apparatus as set forth in claim 1, wherein said feed mechanism comprises:

a first rack mounted on said cylindrical housing and having a column of teeth extending in parallel with said axis of said rotary shaft assembly and facing radially outwardly relative to said axis; and,

a second rack mounted on said body and having a column of teeth extending in parallel with said column of teeth of said first rack with a space interposed therebetween;

said drive member being a pinion positioned between and engaged with said first and second racks so that said cylindrical housing with said first rack is moved in said direction of said axis of said rotary shaft assembly by rotating said pinion.

3. A rotary cutting apparatus as set forth in claim 2, wherein said motor has an output shaft extending normal to the axis of said rotary shaft assembly.

4. A rotary cutting apparatus as set forth in claim 3, wherein said rotary cutting apparatus comprises a magnetic base having an electrical magnet; and,

said body is mounted on said magnetic base such that said rotary shaft assembly is movable on a plane normal to said axis of said rotary shaft assembly.

5. A rotary cutting apparatus as set forth in claim 4, wherein said magnetic base has a pivot member having an axis parallel to said axis of said rotary shaft assembly;

said body is rotatable about said pivot member; and,

said rotary cutting apparatus further comprises a fastener for fixing said body at a desired angular position about said pivot member.

6. A rotary cutting apparatus as set forth in claim 5 wherein, said fastening member has a pair of leg portions and an intermediate portion positioned between said leg portions and surrounding said pivot member, said leg portions each having inner and outer surfaces, said inner surfaces of said leg portions being spaced away from and facing each other;

said body has a guide member having side portions between which said leg portions are positioned and which slidably engage said outer surfaces of said leg portions so that said body with the guide member is movable on said plane along said leg portions; and,

said fastening member further has a fastening bolt laterally extending through and threadably engaged with one of said side portions of said guide member, said fastening bolt having an inner or tip end engaged with one of said outer surfaces of said leg portions in such a manner that, when the fastening bolt is rotated about its axis to advance inwardly, the tip end of said fastening bolt urges one of said leg portions, which has said one of said outer surfaces, towards the other leg portion and finally presses both of the leg portions against the other side portion of said guide member, whereby the intermediate portion of said fastening member is tightened to be firmly engaged with said pivot member and, thus, the body is fixedly secured to said magnetic base.

7. A rotary cutting apparatus comprising:
a body;
a motor mounted on said body;
a rotary shaft assembly having an axis and adapted to hold a cutting tool coaxial with said axis; and,
a feed mechanism for moving said cutting tool held by said rotary shaft assembly along said axis;
said rotary shaft assembly comprising:

a proximal rotary shaft coaxial with said axis, said proximal rotary shaft being mounted on said body for rotation about said axis and drivingly connected to said motor;

a distal rotary shaft coaxial with said axis, said distal rotary shaft being rotated about said axis by said proximal rotary shaft and movable relative to said proximal shaft along said axis between an extended position wherein said distal rotary shaft has been moved in a direction away from said proximal rotary shaft and a retracted position wherein said distal rotary shaft has been moved towards said proximal rotary shaft from said extended position; and

a cylindrical housing coaxial with said axis, said cylindrical housing rotatably holding said distal rotary shaft and movable along said axis together with said distal rotary shaft;

said feed mechanism comprising:

a first rack mounted on said cylindrical housing and having a column of teeth extending in parallel with said axis of said rotary shaft assembly and facing radially outwardly relative to said axis;

a second rack securely mounted on said body and having a column of teeth extending in parallel with said column of teeth of said first rack with a space interposed therebetween; and,

a pinion positioned between and engaged with said columns of teeth of said first and second racks.

8. A rotary cutting apparatus as set forth in claim 7, wherein said rotary cutting apparatus comprises a magnetic base having an electrical magnet; and,

said body is mounted on said magnetic base such that said rotary shaft assembly is movable on a plane normal to said axis of said rotary shaft assembly.

9. A rotary cutting apparatus as set forth in claim 8, wherein

said magnetic base has a pivot member having an axis parallel to said axis of said rotary shaft assembly;

said body is rotatable about said pivot member and has a fastening member for fixing said body at a desired angular position about said pivot member.

10. A rotary cutting apparatus as set forth in claim 9 wherein,

said fastening member has a pair of leg portions and an intermediate portion positioned between said leg portions and surrounding said pivot member, said leg portions each having inner and outer surfaces, said inner surfaces of said leg portions being spaced away from and facing each other;

said body has a guide member having side portions between which said leg portions are positioned and which slidably engage said outer surfaces of said leg portions so that said body with the guide member is movable on said plane along said leg portions; and,

said fastening member further has a fastening bolt laterally extending through and threadably engaged with one of said side portions of said guide member, said fastening bolt having an inner or tip end engaged with one of said outer surfaces of said leg portions in such a manner that, when the fastening bolt is rotated about its axis to advance inwardly, the tip end of said fastening bolt urges one of said leg portions, which has said one of said outer surfaces, towards the other leg portion and finally presses both of the leg portions against the other side portion of said guide member, whereby the intermediate portion of said fastening member is tightened to be firmly engaged with said pivot member and, thus, the body is fixedly secured to said magnetic base.

11. A rotary cutting apparatus comprising:

a body;

a motor mounted on said body;

a rotary shaft assembly having an axis of rotation and a distal end adapted to hold a cutting tool coaxial with said axis, said rotary shaft assembly

being mounted on said body such that said rotary shaft assembly is movable along said axis; and,

a feed mechanism for moving said cutting tool held by said rotary shaft assembly along said axis;

said rotary shaft assembly comprising:

a proximal rotary shaft coaxial with said axis, said proximal rotary shaft being drivingly connected to said motor to be rotated about said axis and movable along said axis between a first position and a second position, said first position being closer to said distal end of said rotary shaft assembly than said second position;

a distal rotary shaft coaxial with said proximal rotary shaft and adapted to hold said cutting tool, said distal rotary shaft being rotated about said axis by said proximal rotary shaft and movable relative to said proximal rotary shaft along said axis between an extended position wherein said distal rotary shaft has been moved in a direction away from said proximal rotary shaft and a retracted position wherein said distal rotary shaft has been moved towards said proximal rotary shaft from said extended position; and

a cylindrical housing rotatably holding said distal rotary shaft and movable along said axis together with said distal rotary shaft;

said feed mechanism comprising:

a first rack mounted on said cylindrical housing and having a column of teeth extending in parallel with and facing radially outwardly relative to said axis

a second rack securely mounted on said body and having a column of teeth extending in parallel with said column of teeth with a space interposed therebetween; and,

a pinion positioned between said columns of teeth of said first and second racks and engaged with said teeth of said columns;

said rotary shaft assembly is moved by said feed mechanism between a retracted position wherein said proximal rotary shaft is in said second position and said distal rotary shaft is in said retracted position and an extended

position wherein said proximal rotary shaft is in said first position and said distal rotary shaft is in said extended position.

12. A rotary cutting apparatus as set forth in claim 11, wherein
said rotary cutting apparatus comprises a gear train positioned
between said motor and said distal rotary shaft; and,
said gear train comprises;
a first flat gear coaxial with and secured connected to said proximal
rotary shaft; and,
a second flat gear engaged with said first flat gear;
said second flat gear having an axial length to enable said first flat
gear to keep the engagement with said first flat gear when said proximal rotary
shaft is moved between said first and second positions.

13. A rotary cutting apparatus as set forth in claim 11, wherein
said rotary cutting apparatus comprises a magnetic base having an
electrical magnet;
said motor has an output shaft extending normal to said proximal
rotary shaft; and,
said body is mounted on said magnetic base such that said rotary
shaft assembly is movable on a plane normal to said axis of said rotary shaft
assembly.

14. A rotary cutting apparatus as set forth in claim 13, wherein
said magnetic base has a pivot member having an axis parallel to
said axis of said rotary shaft assembly;
said body is rotatable about said pivot member; and,
said rotary cutting apparatus further comprises a fastening member
for fixing said body at a desired angular position about said pivot member.

15. A rotary cutting apparatus as set forth in claim 14 wherein,

said fastening member has a pair of leg portions and an intermediate portion positioned between said leg portions and surrounding said pivot member, said leg portions each having inner and outer surfaces, said inner surfaces of said leg portions being spaced away from and facing each other;

said body has a guide member having side portions between which said leg portions are positioned and which slidably engage said outer surfaces of said leg portions so that said body with the guide member is movable on said plane along said leg portions; and,

said fastening member further has a fastening bolt laterally extending through and threadably engaged with one of said side portions of said guide member, said fastening bolt having an inner or tip end engaged with one of said outer surfaces of said leg portions in such a manner that, when the fastening bolt is rotated about its axis to advance inwardly, the tip end of said fastening bolt urges one of said leg portions, which has said one of said outer surfaces, towards the other leg portion and finally presses both of the leg portions against the other side portion of said guide member, whereby the intermediate portion of said fastening member is tightened to be firmly engaged with said pivot member and, thus, the body is fixedly secured to said magnetic base.

16. A rotary cutting apparatus comprising:

a base for fastening said rotary cutting apparatus at a desired position; and,

a body mounted on said base and comprising:

a motor mounted on said body;

a rotary shaft assembly having an axis of rotation and adapted to hold a cutting tool coaxial with said axis; and,

a feed mechanism for moving said cutting tool held by said rotary shaft assembly along said axis;

said rotary shaft assembly comprising:

a proximal rotary shaft coaxial with said axis, said proximal rotary shaft being drivingly connected to said motor to be rotated about said axis;

a distal rotary shaft coaxial with said proximal rotary shaft and adapted to hold said cutting tool, said distal rotary shaft being rotated about said axis by said proximal rotary shaft and movable relative to said proximal rotary shaft along said axis between an extended position wherein said distal rotary shaft has been moved in a direction away from said proximal rotary shaft and a retracted position wherein said distal rotary shaft has been moved towards said proximal rotary shaft from said extended position; and

a cylindrical housing rotatably holding said distal rotary shaft and movable along said axis together with said distal rotary shaft;

said body being movable in parallel with said axis;

said feed mechanism comprising:

a first rack mounted on said cylindrical housing and having a column of teeth extending in parallel with said axis of said rotary shaft assembly and facing radially outwardly relative to said axis of said rotary shaft assembly;

a second rack securely mounted on said base and having a column of teeth extending in parallel with said column of teeth with a space interposed therebetween; and,

a pinion positioned between and engaged with said columns of teeth of said first and second racks.

17. A rotary cutting apparatus as set forth in claim 16, wherein said rotary cutting apparatus comprises a magnetic base having an electrical magnet;

said motor having an output shaft extending normal to said rotary shaft assembly; and,

said body is mounted on said magnetic base such that said rotary shaft assembly is movable on a plane normal to said axis of said rotary shaft assembly.

18. A rotary cutting apparatus as set forth in claim 17, wherein

said magnetic base has a pivot member having an axis parallel to said axis of said rotary shaft assembly;

said body is rotatable about said pivot member and has a fastening member for fixing said body at a desired angular position about said pivot member.

19. A rotary cutting apparatus as set forth in claim 18 wherein,

said fastening member has a pair of leg portions and an intermediate portion positioned between said leg portions and surrounding said pivot member, said leg portions each having inner and outer surfaces, said inner surfaces of said leg portions being spaced away from and facing each other;

said body has a guide member having side portions between which said leg portions are positioned and which slidably engage said outer surfaces of said leg portions so that said body with the guide member is movable on said plane along said leg portions; and,

said fastening member further has a fastening bolt laterally extending through and threadably engaged with one of said side portions of said guide member, said fastening bolt having an inner or tip end engaged with one of said outer surfaces of said leg portions in such a manner that, when the fastening bolt is rotated about its axis to advance inwardly, the tip end of said fastening bolt urges one of said leg portions, which has said one of said outer surfaces, towards the other leg portion and finally presses both of the leg portions against the other side portion of said guide member, whereby the intermediate portion of said fastening member is tightened to be firmly engaged with said pivot member and, thus, the body is fixedly secured to said magnetic base.